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Drawing and Insulating Copper and Aluminum Wire in One Tandem Operation . . . . . Page 6
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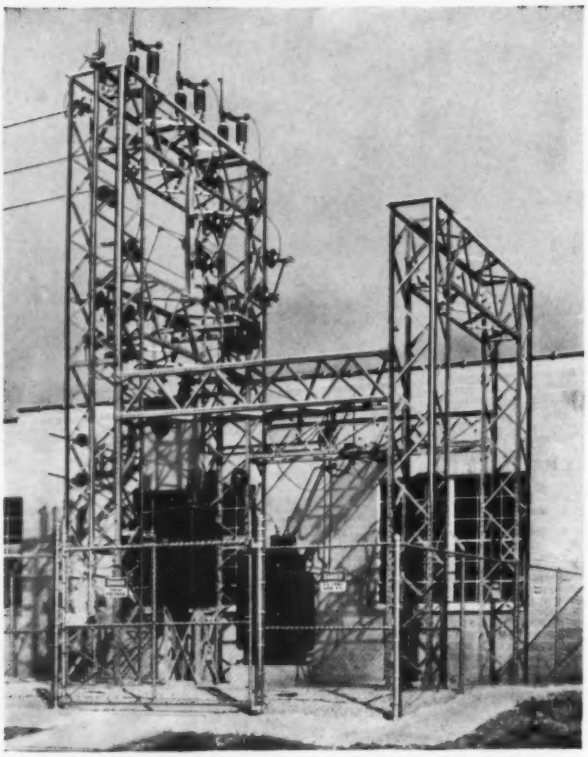
November, 1960
Vol. 13, No. 3



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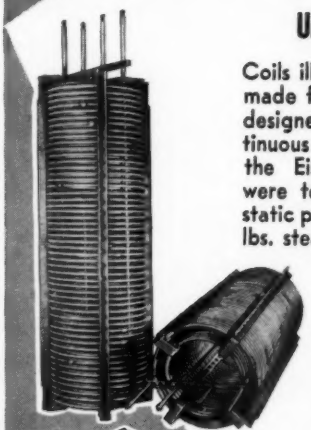

Coils illustrated are a double spiral made from nickel pipe. They were designed for use as part of a continuous fat splitting unit employing the Eisenlohr Process. The coils were tested to 12,000 lbs. hydrostatic pressure for operation at 3,500 lbs. steam pressure and 600° F.

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Combine 1 cup catsup, 1 cup vinegar, ½ cup molasses, ½ cup prepared mustard, ¼ cup Worcestershire sauce, 2 teaspoons liquid pepper seasoning, and ½ teaspoon each: marjoram, oregano, and thyme. (Makes about 3 cups.)
SINGAPORE SLING
"Original" Recipe
Take equal parts cherry brandy, Benedictine, and gin—shake well with crushed ice. Strain into tall glass with ice cubes. Add soda and lime peel.
DEB

A "WESTERN" party with an "EASTERN" theme!

Night in the Orient

Ladies Night at WSE

Tuesday, December 6, 1960

5:30 P.M. ORIENTAL SOCIAL HOUR: Drinks of your choice (Dutch) including the world-famous Raffles Hotel Singapore Sling. Hot and cold Oriental snacks to whet the most jaded appetite.

6:30 P.M. DINNER AT TAI PAK: If you have ever dined at one of the floating restaurants at Aberdeen on Hong Kong Island you will know what a treat is in store for you. At the Tai Pak you would have eight courses. WSE will do it with meat, fish and fowl in the authentic Oriental manner.

8:30 P.M. In the 7th floor auditorium: AROUND THE PACIFIC WITH THE BACONS: Bob and Ruth Bacon will show another of their beautiful color movies, covering the Oriental section of their Pacific trip.

You will see the squalor of Djakarta and the lush beauty of Bali; Singapore and Jahore in Maylaya; and Thailand and Bangkok with some wonderful shots of Thai boxing where the boxers use their feet. A boat trip along the klongs will show you how the Thais really live, and the magnificence of the palaces and temples.

In Cambodia you will see fascinating Angkor Wat and Angkor Thom — the amazing ruins of a bygone age. Hong Kong will be next, with all of the color of the old China, and you will see a piece of Red China.

Bob and Ruth have caught the human side of the Orient — of the people, the children and many things that not even the professional travellogists seem to be able to get.

So, here's another great evening. Be sure and come early. Send in your Reservation and Check now so that you won't be disappointed.

Here's Last Call . . .
What's Your Answer?

The Western Society of Engineers has been asked to sponsor a two-day (Fri. and Sat.) short course in Use-Inspection-Design of Prestressed Concrete.

Would you be interested in attending such a course?

If you are interested, call or write your Society at once to that effect. Whether such a course is held depends to a great extent upon your response at this time.

Write to the Western Society of Engineers, 84 East Randolph St., Chicago 1, Ill., or call RAndolph 6-1736. If you are interested, do it today.

Midwest Engineer

Telephone: RAndolph 6-1736
84 E. Randolph St., Chicago 1

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Thing
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Is
the Proper to do?

NOTE: This column deals with standards of conduct in the engineering field. The editor invites comments and criticisms on the ethical problems considered herein. Questions submitted on engineering ethics will be given careful attention. You should address your letter: The Editor, Midwest Engineer, 84 E. Randolph St., Chicago 1, Ill.

Situation: An engineer is retained by an individual to make a design. The engineer indicates that his fee will be on a strict time basis and the client will be billed monthly. After the second month's bill, the client complains to the engineer that the fee is very high and the client wants to know how much the job will cost over-all. The engineer says, "We are just about finished and it won't cost much more." The next month's bill is equal to the previous month's bill and, again, the client asks how much the bill will be and complains. The engineer gives the same answer and the fourth month's bill is equal to the third month's bill.

Question: Is the engineer acting in an ethical manner?

Reply: It is unethical to deceive a client. The engineer is in the wrong. (a) Assuming the engineer is competent, he should have given the client a rough estimate of the cost, and (b) If unusual and unexpected circumstances had developed, the engineer should have given a progress report and an explanation for the increased cost.*

*An opinion of the Panel on Engineering Ethics of the Division on Education and Research of the Western Society of Engineers.

Calendar of Chicago Engineering

—NOV. 16, WED., WSE Noon Luncheon Meeting (12:00 noon). At WSE Hq.

—NOV. 16, WED., WSE Civic Committee Dinner (6:15 p.m.) and Meeting. At WSE Hq.

—NOV. 22, TUES., WSE General Meeting and Dinner. Social Hour (5:15-6:15 p.m.) Dinner (6:15). Dinner Speaker (7:15-7:45). Technical Sessions (8:00). At WSE Hq.

—NOV. 23, WED., NO WSE NOON LUNCHEON MEETING because of proximity to THANKSGIVING.

—NOV. 28, MON., Young Engineers Forum. Social Hour (5:30-6:00 p.m.) Dinner (6:15). At WSE Hq.

—NOV. 30, WED. NO WSE NOON LUNCHEON MEETING. Reserved for ASME. Contact Chicago Section of ASME for tickets.

—DEC. 5, MON., Young Engineers Forum. Social Hour (5:30-6:00 p.m.). Dinner (6:15). At WSE Hq.

—DEC. 6, TUES., WSE Ladies Night "Night in the Orient." Features: Oriental food, Oriental refreshments, and Oriental entertainment. Social Hour (5:15 p.m.). Dinner (6:30 sharp). At WSE Hq.

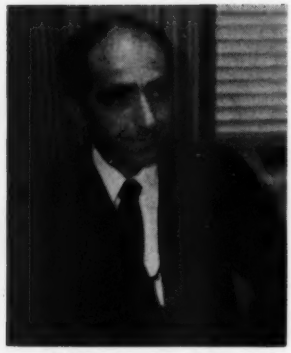
—DEC. 7, WED., WSE Noon Luncheon Meeting (12:00 noon). At WSE Hq.

—DEC. 14, WED., WSE Noon Luncheon Meeting (12:00 noon). At WSE Hq.

Acute Idea

An Australian product that keeps permanent pleats in pants and skirts will be on the U. S. market soon, *Textile World reveals.* In the process, wool is treated with an acid that works on it like a permanent wave on human hair.

WSE's General Meeting on October 25



Above, left. Howard A. Carter of the firm of Carter and Hormquest. WSE's Program chairman, he presided over the Dinner Meeting at the Western Society headquarters on October 25.

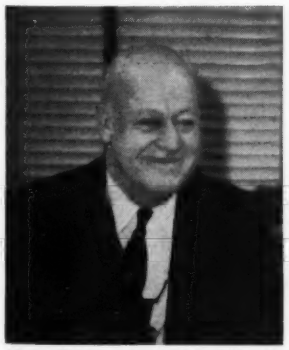
Right-hand picture. Dr. Abbas Kessel, engineer, lecturer, and native Iranian. Dr. Kessel was the Dinner Meeting speaker. He gave his interpretation of "The U.N. and the Congo."

AT

Left-hand picture. A. N. Eliasen (left) of Sargent & Lundy, and G. Leslie Welch, WSE Electrical Engineering Section chairman. Mr. Eliasen discussed (with Mr. E. C. Bailey) "The Unit 4 Turbine Generator Installation" at Commonwealth Edison's Will County Station.

THE

Above, right. E. C. Bailey, of Commonwealth Edison Company, talked (with Mr. A. N. Eliasen) about his company's Unit 4 installation at the Will County Station.



Right-hand picture. James M. Poole of E. I. du Pont de Nemours & Company, spoke on "Know Your Motor Oil." He told of the significance of SAE viscosity designations, and emphasized the importance of using oils of the right viscosity.

SPEAKER'S

Above, left. Dr. Austin B. Wilder of the du Pont Company, is chairman of the Western Society's Chemical and Metallurgical Section.

Left-hand picture. R. W. Beecher, also of du Pont, spoke on "Du Pont's Safety Control Program," a preview of a new safety technique. The program is a new approach in the field of safety.

TABLE

Above, right. Frank M. Scott, Western Society 2nd Vice President, completes the list of those sitting at the Speaker's Table. He is manager, Utility Sales, Allis-Chalmers Mfg. Company.

In One Tandem Operation

DRAWING AND INSULATING COPPER AND ALUMINUM WIRE

Automation, in most cases, is the result of an evolution of manufacturing techniques — a gradual increase in mechanization. The combining of several previously independent wire processes is part of the evolutionary pattern.

By James F. Stoltz

Engineers at Western Electric have developed a new combination of older processes to draw, anneal, and insulate copper wire with plastic in one continuous tandem operation.

The tandemization of these wire processes reduces the required facilities and floor space as well as the production costs, primarily by the elimination of the transfer of material between the individual processes. Additional by-product advantages are the mechanical superiority resulting from a higher uniformity of wire tension and fewer difficulties with the heavier supply wire, producing a slight increase in output for the insulating line.

Some of the problems encountered in proving in the system and determining its feasibility were most interesting. For a better understanding of these problems, a brief description of the tandem line is in order.

The Tandem Line

The schematic diagram, located at the bottom of the next page, represents the arrangement of the component machines in the line. Fourteen gage hard copper wire is supplied to the line on 1,000-pound spools. This wire enters a wire drawing machine (in a typical case) at a speed of 198 feet per minute and emerges as 24 gage wire at 2,000 feet per minute.

Being work hardened in the drawing process, it is necessary to anneal the wire "on the fly" so that it will meet the elongation requirements of the finished product. Annealing is accomplished by passing the wire over driven capstans which are electrically connected to pass a current through the wire from one capstan to another. The current is high enough to cause the wire to be annealed by the resistance-heating effect of the current. Inasmuch as copper oxidizes with amazing rapidity when heated to the annealing temperature range in the presence of air, the heated span of wire is passed through a tube which is purged with steam. Further, in order to cool the wire to a non-oxidizing temperature before it reaches the air again, the hot wire is passed through a water-filled tube. The wet wire emerging from this cooling tube must be dried, however, and an elevated temperature is almost mandatory to do this effectively. At first drying was done by cooling the wire only partially—to a temperature just low enough to prevent oxidation as well as an undesirable adherence of the plastic insulation to the conductor, which occurs when the wire is too hot. Temperature control by this method was unsatisfactory, however, and a reheating circuit operating on the same principle as the annealing circuit was incorporated in the line. By pro-

Mr. Stoltz was graduated from Ohio State in 1935, and has been employed by Western Electric in Chicago since 1940. He was in charge of engineering for the rod and wire mills during the course of this development.

This article originally appeared in the Western Electric publication, The Engineer, and is being reprinted in conformance with the Jackling bequest to The Western Society of Engineers. Western Electric is one of the world's largest producers of wire and cable and consumes approximately 7 per cent of the world's supply of copper in manufacturing equipment for the Telephone Industry.

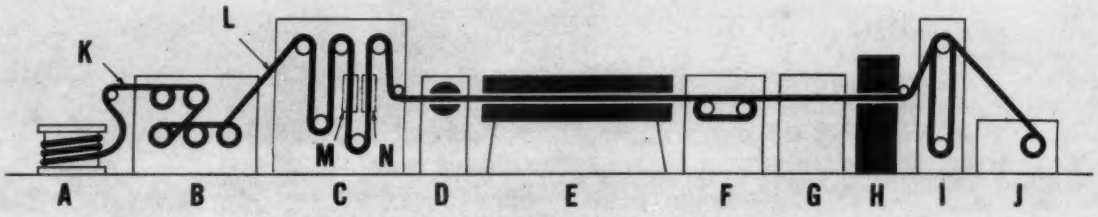
viding more complete cooling followed by the reheat, adequate temperature control was achieved.

The dry annealed wire is passed through the extruder die which applies a plastic insulation over the copper conductor. The plastic is necessarily hot and soft as it is applied, and so must be cooled before the wire makes any further solid contact with sheaves or capstans. For this purpose, the wire travels through a water trough immediately upon leaving the extruder die. The trough is fairly long so that the cooling time is sufficient to permit winding the wire around a double-wheel grooved capstan located at the exit end of the trough. Enough turns are made around this double capstan to assure non-slip operation with normal tension in the wire. Following the capstan, the wire passes through a spark tester to provide continuous testing of the insulation for voltage breakdown, followed by a photo-electric type diameter sensing device, wire accumulator, and finally the continuous spooler. The spooler is a dual unit type with means for on-the-fly transfer of the wire from one spool to the other so that the line can continue to operate while full spools are replaced with empty spools. Rotating speed of the spools is controlled by the wire accumulator to provide automatic control of take-up speed as the diameter of the spool is increased by filling with wire.

Speed Control

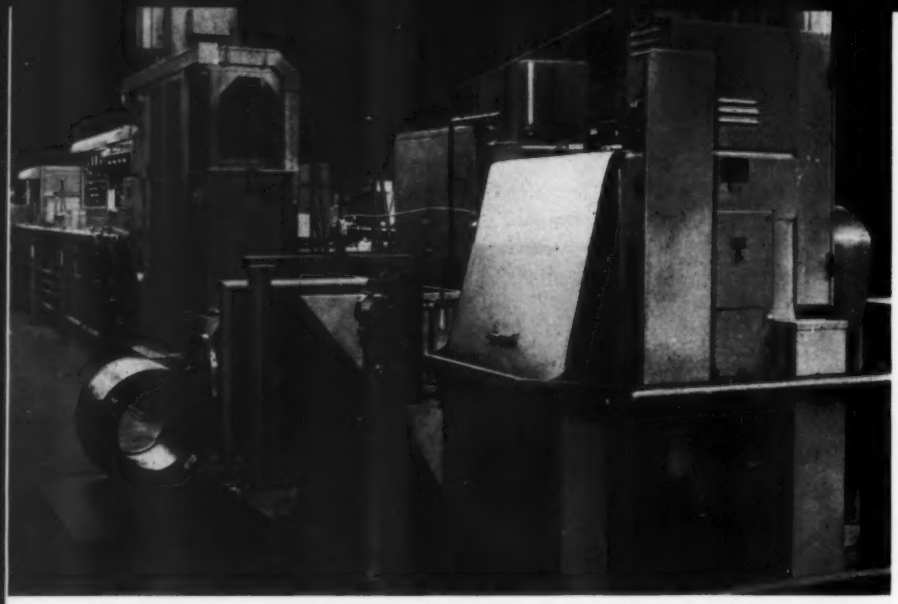
The wire drawing machine, annealer, extruder, and capstan units are each driven by a Dynamatic motor-clutch combination to provide variable speed control through variation of the field strength of the magnetic clutch. Field current for each clutch is supplied through an electronic amplifier so that relatively delicate sensing devices may be used to determine speed relationships. The speed of the extruder (rate of plastic extrusion) is determined by a manual setting of a potentiometer. The speed of the wire drawing machine is controlled by the photo-electric diameter sensing device. Thus, outside diameter of the insulation is automatically controlled through regulation of the speed relationship between the extruder and the wire. This effect is achieved indirectly, since the wire speed is actually determined by the speed of the non-slip capstan. This capstan and the annealer are synchronized to follow the speed of the wire drawing machine.

Exact synchronization for continuous wire machinery is particularly critical since any error which is present is accumulative. Also, the re-machining of capstans, needed occasionally to overcome the effects of wear, demands an increase in rotational speed to compensate for the diameter reduction. Maintaining exact synchronization during such changes is very difficult. The synchronization problem may be treated in several ways—in this case it was alleviated by providing for a few percent of slip on the capstans of two of the three interconnected units. By causing the slip to occur at the wire drawing and annealing units, another important advantage was gained. It is a well known fact that the tension required to pull wire through a drawing die with a given diameter reduction is independent of speed. In addition, when the wire is passed over a slipping capstan, the familiar formula for slipping belts applies and therefore, a constant ratio is maintained between the tension of the wire approaching the capstan and the tension of the delivered wire. The constant tention provided by the drawing die combined with the constant tension ratio which is an inherent characteristic of the slipping capstan results in a highly constant tension in the delivered wire. This tension is completely independent of speed so long as any amount of slip is maintained. The wire delivered in this fashion by the drawing machine is similarly treated by the annealer so that constant tension is maintained throughout both units, an advantage not realized with conventional operation where the wire paying off a supply spool enters directly into the annealer. However, the high degree of tension control is of utmost importance



SCHEMATIC REPRESENTATION OF A TANDEM LINE

A—1,000-pound supply spool
B—Wire drawing machine
C—Continuous annealer
D—Plastic extruder
E—Water cooling trough
F—Non-slip capstan
G—Voltage breakdown tester
H—Photo-electric diameter senser
I—Wire accumulator
J—Continuous spooler
K—14 gage wire entering drawing machine
L—24 gage wire entering annealer
M—Steam tube in annealer
N—Water cooling tube in annealer



The wire drawing machine, at right, receives wire from a pay-off stand located immediately behind it, delivers hard wire, shown leaving the top of the machine, to a continuous annealer located next in line. The cooling trough of the plastic extruder is shown beyond the annealer.

in the case of aluminum where tension must be very low and highly uniform in the annealer to prevent objectionable stretching.

Methods for Controlling Clutches

In order to evaluate the relative merits of alternative methods for controlling the Dynamatic clutches to maintain the desired speed relationships, two separate systems were tried.

The first made use of the tachometer generators which are an integral part of the Dynamatic units themselves. The tachometer signal voltage of each of the follower (slave) units was compared to that of the master unit. Differences in these voltages were employed to control the clutch field amplifiers. While this method produced satisfactory operation, there was some instability of the electronic circuits and adjustments were difficult because of the complexity of the system.

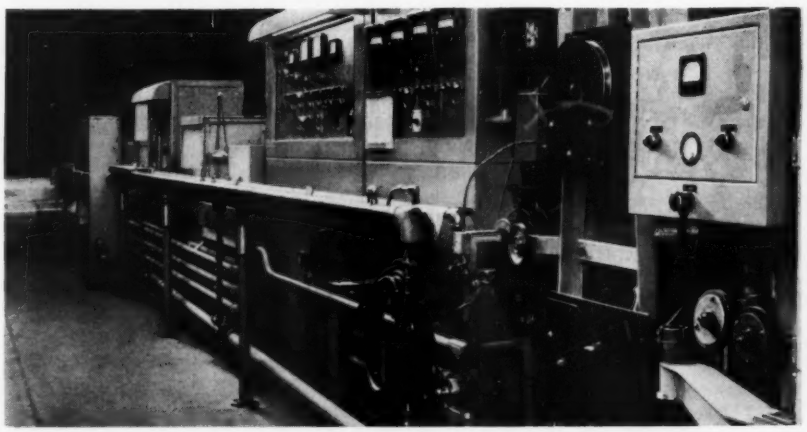
The second system employed differential Selsyn units installed at each machine to maintain the necessary synchronization. This method has the advantage of being self compensating with respect to electronic instability as well as any improper adjustments and has proven to be highly satisfactory in regular production service.

A third method of synchronization is being employed for a newer tandem line which has been installed at the Montgomery Shops. This method is the power Selsyn system which is frequently used in steel rolling mills. In this line, the master unit (wire drawing machine) has a Dynamatic drive as previously described. A master power Selsyn unit is driven from the same Dynamatic and is positively geared to the wire drawing machine through timing belts. The annealer is mechanically driven from the wire drawing machine and a slave Selsyn unit drives the non-slip capstan. This system requires virtually no adjustment or attention. It is further considered superior to the other two control systems because of its more positive action, quicker response, simplification, and the economic advantages gained by the elimination of many control components.

This line includes an additional noteworthy feature, an electro-tinning operation between the annealer and the extruder. The tinner is a multipass unit containing four driven electrical contact rolls which pass the wire through a stannous sulphate solution. In this case, a soft-torque non-slip method of synchronization was selected since a slipping contact roll might be deleterious to the quality of the tin coating and because accurate tension control is much less important in the tinner than it is in the annealer where elevated temperatures are employed. Small Dynamatic units drive each roll separately to provide this type of control.

Initial Experiment

The initial experimental work on the tandem line was accomplished by converting a conventional plastic insulating line to tandem operation. For production reasons, the line had to be returned to full three-shift operation on regular product, with or without the tandem ration, within two weeks. The first of three primary objectives of the experiment was to determine the feasibility of tandemization. Secondly, it was important to determine whether tandem operation would, in any way, interfere with a subsequent conversion from copper to aluminum conductors. The third goal was the establishment of operating procedures and preparation for regular shop production on the tandem line by the end of the two-week interval.



The extruder head which applies plastic insulation to the annealed wire is located in front of the entrance to the cooling trough. At the far end of the trough is the non-slip capstan which governs the wire velocity on the line.

After spending the first three days in making final connections, adjustments, and testing of the complex control circuits involved in the line, ex-

perimental work was begun. The first objective was achieved without major engineering difficulty. Twenty-two gage copper wire was drawn from fourteen gage supply and delivered continuously to the remaining components of the line under highly uniform tension as predicted. Quality of the finished insulated wire was checked carefully and found to meet all requirements. After producing a sufficient quantity of wire to establish complete assurance of ultimate success for copper wire, this work was temporarily suspended in favor of a pursuit of the more challenging second objective to achieve successful operation with aluminum wire.

Because plastic insulated aluminum wire was not in regular production, a number of problems were expected which were not necessarily related to tandemization. It was not the purpose of these experiments to find a solution to all of these problems, but rather to confirm their existence, evaluate the influence which tandemization would have on their solution, and solve any problems arising directly from tandemization.

One such problem concerned the very low yield point of aluminum at elevated temperatures and the corresponding low tension which could be allowed in the heated span of the annealer to permit feasibility of such an annnealer, so necessary to tandem operation. Any stretch occurring in the wire at this point would reduce its cross sectional area and increase its resistance accordingly. For the initial trials on aluminum, therefore, it was decided that the lowest possible tension would be provided in the heated span of the wire. Fortunately, aluminum does not oxidize a great deal faster at the annealing temperature than it does at room temperature, so that the steam tube could be removed, permitting easy observation and measurement of tensions.

In a system of slipping capstans such as that used in the annealer, only a few factors have a major influence on the tension ratios. Specifically, these are angular contact between the wire and the capstan, coefficient of friction, and direction of slip. Factors which are normally minor, but which can sometimes become important, are windage, centrifugal force, and the weight of the wire. Except for lubrication, not much can be done about the coefficient of friction and arrangements were made, therefore, to increase angular contact on the capstan preceding the heated span by providing an extra wrap. Anticipating that the tension thus produced would be too low for good electrical contact on the next capstan (at the other end of the heated span), the direction of slip was reversed here by underdriving this capstan to a peripheral speed slightly slower than that of the wire. This change was expected to increase tension in the water cooled span to provide good electrical contact on the aforementioned capstan.

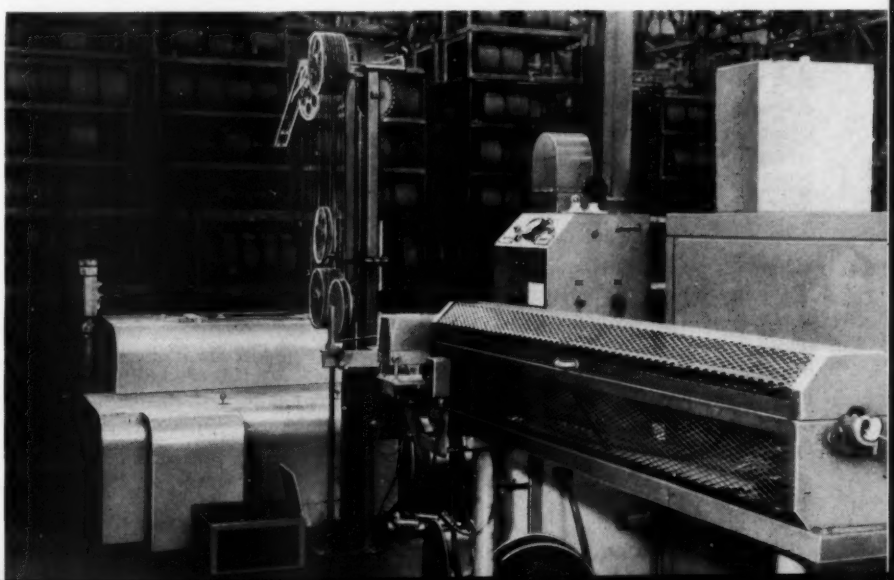
No attempt was made to apply the plastic insulation during the first runs. Samples of the annealed aluminum wire were carefully checked for diameter, resistance, and elongation. All three of these measurements indicated that the wire was being stretched in the process. Moreover, after running aluminum through the annealer for a short time, a coating of aluminum and aluminum oxide covered the capstan faces and increased the coefficient of friction so that tension in the heated span was reduced even further. Under this condition, the wire became virtually uncontrollable in the annealer. Centrifugal force of the wire on the capstans became a significant factor at the 2,000 feet per minute speed with the result that the heated span was transformed from a straight span of wire to a careening "S" shaped path of wire.

This condition was corrected by removing the extra wrap of wire from the capstan and it was later concluded that while aluminum does require lower tension in the annealer, this is provided automatically after a short run by the increase in coefficient of friction. Subsequent runs demonstrated that stretch was still occurring and it was found that this same increase in friction caused more tension in the water cooled span than the soft annealed wire could withstand. The under-driven capstan was, therefore, promptly changed to over-drive, contrary to conventional practice. Fortunately, and probably due to the presence of water on this capstan, good electrical contact was maintained even with the lower tensions. After eliminating several minor drag points throughout the system it was finally possible to deliver good quality bare annealed aluminum wire to the extruder die on a reliable basis without significant or even measurable symptoms of stretch.

Measuring Stretch

During the course of these runs, considerable delay was involved in obtaining samples of the annealed wire being delivered to the extruder die. It was known that some stretching occurred at the wire accumulator and spooler units, so that a sample taken from a take-up spool would not be representative of the wire delivered by the annealer. Therefore, it was necessary to obtain samples by cutting the wire at the exit end of the cooling trough while it was running at full speed. With the slipping drive principle employed, this action caused the wire to stop almost instantly, even though the capstans continued to rotate

Insulated wire from the non-slip capstan is shown entering the voltage breakdown insulation test set, at right, whence it goes to a photo-electric diameter senser, a wire accumulator, and a continuous take-up spooler in the background.



(and slip). This method had the advantage that samples could be taken from various points in the system to help locate the trouble spots, but also meant that the entire line had to be restrung after each sample was taken.

To minimize these delays which might have spelled the difference between success and failure within the allotted time available, a method was devised for detecting stretch while the line was in continuous full-speed operation. The method was based on the principle that when stretching occurs in the process, the unstretched wire at the beginning of the system cannot be traveling at the same rate of speed as the elongated wire at the end of the process. In this case, the speed of the wire on the double wheel non-slip capstan is essentially constant and when stretching occurs in the soft wire, the speed of the wire entering the annealer is reduced. If stretch is appreciable, it can be detected easily with an ordinary tachometer type speed indicator. For the detection of smaller amounts of stretch, the stroboscopic tachometer was suitable. While this latter instrument is not completely dependable for absolute speed measurements, it is especially sensitive to relative speed changes. By switching the annealer current on and off with the wire running and while one of the idler sheaves was observed in the light of the stroboscope, minute amounts of stretching in the soft wire could be detected readily.

In some cases, by observing any time lag between application of the annealing current and an indication of stretch, an approximation can be made of the location of the trouble. For example, if an estimated one-second time lag is observed, it can be assumed that it took that long for the soft wire to reach the point at which it is being stretched. At a speed of 2,000 feet per minute, this would be about thirty-three feet from the annealer. If the indication is immediate, the trouble is undoubtedly located in the annealer itself,

Having successfully produced bare aluminum wire of good quality over the tandem system, the next step was to apply the plastic insulation. This introduced a new stretch point due to the drag in the extruder die which was being used at the time. Inasmuch as this was not related to tandemization, however, no attempt was made to correct the trouble during the limited time available. To confirm the conclusion that this difficulty was not related to tandemization, a small quantity of soft aluminum wire was insulated in the normal manner, by-passing the wire drawing machine and annealer, with similar results.

The engineers now turned to the establishment of operating procedures for the production of copper wire on a routine basis by shop personnel. Operators having relatively short service and no experience with tandem operation were employed to run twenty-two gage and twenty-four gage insulated copper wire. With the exception of some interruption for experimental adjustments to determine optimum conditions, output during the remaining two days was comparable to that for conventional extruder line operation. This was accomplished in spite of the fact that provisions had not yet been made for transferring on the fly from one supply spool to the next—a common practice for conventional operation. This necessitated stopping and re-starting the line with each change of supply spool and was corrected a short time later.

In view of these favorable results, tandem operation was scheduled for use at the Western Electric cable plant at Omaha. Fifty-four tandem lines were scheduled for installation, twelve of which were to include the tinning process. The lines, it was believed, would reflect the accumulated experience by incorporation of power Selsyn drives and the features found most desirable in operating the two existing lines. Prove-in time should be reduced because of the previous experience. By eliminating the need for wire drawing machine spoolers, a large number of spools, and associated handling equipment, the initial investment for facilities at Omaha could be reduced considerably. The saving of about 4,300 square feet of floor space would result in a reduction of manufacturing costs of several hundred thousand dollars annually.

This development is considered to be only one step of the inevitable march in the direction of automation and the automatic factory. To constitute sound progress, of course, each step must be supported by lower costs, improved quality, or improved service to the ultimate customer. Tandemization as applied here is one such step.

Gunlock Presented Colorful Oil Painting

Historical significance of rapid transit train operation in the right-of-way of the Congress expressway is colorfully preserved for posterity in an original oil painting presented September 12 to Western Society Trustee V. E. Gunlock, chairman of Chicago Transit Board. It is reproduced on the Front Cover.

The presentation was made by George L. Irvine, regional vice-president of the General Electric Company, at a luncheon.

A Chicago "first" in the field of urban transportation is commemorated:

> The new Congress expressway, first multi-lane, limited-access highway designed and built for rail transit and automobile transportation in a common grade separated right-of-way.

In the brush-strokes of the noted artist, John Gould, CTA's high-performance rapid transit cars in their colorful coats of green and cream paint come to life in the median strip of the Congress expressway, speeding on their appointed task of providing fast, safe transportation. A reproduction of the painting illustrates the month of November in General Electric's calendar for 1960.

The combination of rail and automobile transportation in the same right-of-way represent a major means of solving the transportation problems of the nation's heavily-populated metropolitan areas.

Rapid transit service over the two tracks of the Congress expressway began June 22, 1958. Although rail passenger volume is presently about 30 per cent of potential maximum, expressway trains are already carrying about 150 per cent more riders in the rush direction in rush hours than the automobiles on the expressway lanes. The highway, moreover, is rapidly approaching its design capacity.

The Congress expressway has attracted world-wide attention. Transit operators and engineers, planners and public officials from all parts of the United States and Canada, and from many other countries have come to Chicago to tour the project and obtain first-hand knowledge of the design.

Soil-Cement Celebrates 25th Year

A Silver Anniversary—a milestone in roadbuilding—will soon be observed in South Carolina.

Twenty-five years ago, in the fall of 1935, the first scientifically controlled road constructed of soil-cement was completed by the South Carolina State Highway Department. When this modest 1½-mile project was opened to the public, it produced little interest outside engineering circles. But, actually, it marked a major break-through in highway construction techniques that opened the way for construction of more than 24,000 miles of soil-cement paving in the United States and Canada, plus millions of additional square yards over the globe from Alaska to Guam.

A quarter-century after its completion, this same secondary highway near Johnsonville is in daily use, serving an increasing traffic load. In the early months following its opening, only a few hundred vehicles per day used the highway; twenty-five years later, the load has increased to more than 2,000 vehicles per day. In the meantime, the soil-cement base has actually *gained* in strength!

To drivers who wonder if they have ever driven over soil-cement roads, the answer is "very probably," since there is some mileage in every state. The surface "topping" is the fooler. Soil-cement is a tightly compacted mixture of pulverized soil or roadway material, and precisely measured amounts of portland cement and water. As the cement hardens, the mixture becomes a strong, durable pavement *base* generally about six inches thick. To complete the pavement, a relatively thin asphalt "wearing surface" is placed on top. One seldom sees the underlying soil-cement that carries the load . . . just the surface.

Roads From The Earth

One of the leading factors behind the growth of soil-cement for street and highway construction is the availability of materials at little or no cost. The soil constitutes 85 to 90 per cent of the finished pavement base. Generally, it is readily obtained either at the paving site, or from a nearby source, so that only the cement and water need be transported.

At the time the Johnsonville road was constructed, most engineers looked on the venture as a revolutionary new idea that might provide a satisfactory pavement at low first cost. Today, soil-cement is extensively employed to pave not only light traffic roads, streets, airports and parking areas, but is also used for subbases beneath heavy duty concrete pavements, and for shoulders on Interstate System highways. Where once there was concern that excessive water would cause disintegration, it is now being utilized to line reservoirs, ditches, irrigation canals and other types of water supply and drainage structures. Its popularity and versatility have continued to grow. During 1959, alone, 46 million sq. yds. of soil-cement were put in place.

Early Development

Years of research went into the development of soil-cement. Among the state highway departments which pioneered in this venture were those of California, Iowa, Ohio, South Carolina, South Dakota and Texas. Their initial efforts date back to the 1920's when the respective highway departments of these states sought ways and means of blending soil and cement to construct a paved surface. The science of mixing these two ingredients in exact proportion and properly compacting them at that time was new, so that the results were seldom successful.

The year 1929 marked the first real step forward, with the discovery of what engineers call the "moisture-density relationship" in soil compaction. In lay language, this established that it was possible to compact a roadway to a specified density predictable in advance in the laboratory. Various soils require different quantities of cement and water, and have since been exhaustively classified, so that today the amounts needed can be readily determined after a sample laboratory analysis.

The second step forward was taken in 1932. The South Carolina State Highway Department initiated a series of experiments including several test sections of roadway. The results of these ventures were promising, and lead to

The first scientifically controlled highway built of soil-cement was six months old when the top photograph was taken early in 1936.

Twenty-five years later, this same section of South Carolina 41 near Johnsonville is providing excellent service despite a traffic load that has increased from a few hundred to more than 2,000 vehicles per day.

an extensive research program by that Department and the Portland Cement Association.

Predictable Results Possible

It was discovered that if the moisture-density tests were combined with durability tests, encompassing cycles of freezing and thawing and wetting and drying, that very predictable field results were possible.

The cumulative result of these laboratory tests was a joint venture undertaken by the South Carolina State Highway Department, the Bureau of Public Roads and the Portland Cement Association. This was construction of the pioneer 1½-mile test section of soil-cement pavement near Johnsonville, South Carolina; the same section still carrying traffic 25 years later.

Spurs Efforts in Other States

Viewing the success of the South Carolina project, other states followed suit. Illinois, Michigan, Missouri and Wisconsin initiated their own experimental projects the following year, with additional soil-cement work also being instituted in South Carolina. Two years later, eight more states launched projects. Today, soil-cement is accepted as a major type of low-cost paving in all 50 states.

World Wide Use

As soil-cement established itself throughout the United States, the rest of the world began to take note. Reports came from France in 1940, that traffic tests made on a circular track in Paris had demonstrated the "very great superiority" of soil-cement mixtures "under experimental conditions." In South America, the road department of Argentina established itself as one of the pioneers in this field, by initiating a testing program as early as 1939. Considerable laboratory research and field work were also conducted in England just prior to World War II, and are still continuing. Reports of success came from the Union of South Africa, Germany and many other nations of the world.

England, France, Germany, China, Japan and Australia were among the first nations to realize its adaptability to construction under wartime conditions. One of the first military uses reported was in the construction of a road, by the Chinese government, between Sian and Lanchow along the route of an old Russian caravan trail.

The U. S. Army Corps of Engineers constructed a number of defense installations using soil-cement, starting first with construction of air bases in the United States, and then overseas.

Soil-Cement in the Years Ahead

As present-day deposits of good quality granular materials are being depleted in some areas, highway engineers are taking another look at soil-cement as the ideal paving material of the future. For among its most noteworthy characteristics is the fact that old granular base pavements can be literally torn up, processed and turned into new pavement. In this procedure, the existing material in place is pulverized, then mixed with cement and compacted to form an adequate new surface without the addition of new stone or gravel.

The tremendous growth of soil-cement construction over the past quarter of a century lends importance to its Silver Anniversary. From a modest start it has helped bring better, more adequate roads, streets and airports to thousands of cities and communities over the world. Most drivers are unfamiliar with its origin, but they owe a debt of gratitude to the foresight of those scientists, engineers and highway officials who gathered at Johnsonville 25 years ago.

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Whence the Accuracy of Polaris

Without showing so much as a periscope tip, the U.S. Navy's nuclear-powered Fleet Ballistic Missile submarines can launch Polaris, one of the Free World's most accurate and reliable weapons, from the ocean's depths into the heart of any aggressor nation. Proof came recently when the U.S.S. *George Washington* fired two of the stubby missiles some 1100 miles downrange from a submerged position off Cape Canaveral to impact "on target."

This amazing accuracy—comparable to a pitcher throwing a no-hit game with a blindfold on, and not missing a strike—is only possible because of a brand-new generation of technical instruments within the control room of the submarine. These instruments indicate everything from sub position and depth, to angle, attitude, balance, temperature of the water, depth of water under the keel, and speed.

They provide the launch control officer with all the data he'll need to program the computer within the Polaris missile to hit the target selected.

One of the unique instruments used in these new FBM (Fleet Ballistic Missile) subs is the "Level-Tel," manufactured by the Aeronautical and Instrument Division of Robertshaw-Fulton Controls Company, in a plant not far from world-famous Disneyland at Anaheim, Calif. Robertshaw-Fulton, which has its corporate headquarters in Richmond, Va., has eight manufacturing plants and two research centers in the U.S.

"Level-Tel" is an all-electronic device which can measure the amount of weight of any material within a container of any shape, and indicate this as a linear read-out on one or many meters placed wherever needed. It detects the level by comparing the electrical capacitance of the container in which the probe of the instrument is placed with the electrical capacitance of the container when empty. Since every material has a capacitance different from air, "Level-Tel" merely measures the change in electrical capacitance as material is added to or taken from the vessel, and indicates this on a meter. The meter can be calibrated to show whatever information is needed in terms of difference between all-air, partially-air, and no-air in the vessel.

Because it is nonmechanical and cannot be jammed by rusting, clogging, or as a result of violent maneuvering, "Level-Tel" was selected by the Navy for sea-water tanks used to trim the submarine. These trim tanks, located along the length of the sub, are constructed around the working and living spaces (called the inner hull), and their outer walls form the exterior or hull of the sub.

Naturally, the weight of water in each of the trim tanks must always be known in order to keep the submarine neutrally buoyant. Then the diving planes can be used just as the elevators in an airplane are used, to climb or dive. In addition, careful balancing of the weight of various parts of the submarine is needed prior to launching to aim the missile properly and to avoid throwing the submarine out of control through sudden release of the missile.

The ballast and trim tanks must fit around an inner hull that has many variations in shape due to the thousands of important components that must be crammed within it. Yet the submarine must present a smooth, streamlined exterior to the water. Because of the uneven width of the tanks, conventional level-measuring systems simply cannot indicate the quantity of water in any of these oddly shaped tanks. "Level-Tel"

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can, however, because it consists of snake-shaped probes and precise electronic circuits set to indicate, with great reliability, water in any shape of tank. By merely bending the probes into the specific shapes required to twist and turn throughout the weirdly shaped tanks, oddities in the width of the tanks can easily be taken into consideration.

"Level-Tel" has been used for some time in ballast and fuel-oil tanks on conventional "fleet-type" submarines. Having proved its reliability in the older standard subs, it was natural that this device should be selected for use aboard the Navy's newest and most powerful. Its current use on the nuclear-powered Polaris-firing FBM subs makes Robertshaw's "Level-Tel" an important member of the Polaris instrument family.

A.R.F. Does Lunar Drill Research

It's not "How high the moon," but how hard?

That's one of the scientific problems facing a research team at Armour Research Foundation which is in the first stages of designing a device for automated drilling on the moon.

The "moon drill" would be operated from a spacecraft placed on the moon. The U.S. is planning to send several unmanned vehicles to the moon in the next two or three years to gather scientific and technical information.

The moon's hardness is only one of many factors that ARF researchers will have to consider. Others are:

—Extreme temperature conditions. During the lunar day, the surface temperature can reach 276°F., and it can drop to 184°F. below zero during the lunar night. (Lunar days and nights have a duration of about two weeks.)

—Atmospheric pressure. As far as scientists know, the moon's surface is almost a vacuum. Therefore, it will be necessary to determine if the drill unit can work in this "vacuum," or whether it must be pressurized, with only the drill bit exposed.

—Weight, volume and power requirements. The drilling unit will be designed to meet the over-all design needs of the spacecraft, as part of the National Aeronautics and Space Administration program. The magnitude of the primary power supply must be determined, as does the question as to whether the drill unit will be operated by hydraulic, explosive, reaction, electric, or vibratory means.

—Drilling methods. Slow speed continuous drilling or high speed intermittent drilling? Researchers must consider subsurface drilling techniques, such as cable, rotary, and diamond drilling.

—Design and wear of the drill bit. Some scientists believe that the moon is covered with layers of dust. The drilling unit must be able to drill through and retain samples of both rock and dust.

—Landing impact. Drilling operations will be attempted on a "soft" landing on the moon, that is at a speed of about 30 feet per second. The impact of the landing will influence the size and shape of the drill unit and material choices.

The necessity for complete automation of the drill unit (means for replacing drill bits, telescoping the drill shaft or adding sections to it) also poses some ticklish problems. The "moon drill" will be outfitted with a telemetering device so that all information can be relayed to scientists on earth.

ARF's lunar drill research is being done for the Jet Propulsion Laboratory at California Institute of Technology. It is being headed by Norman W. Carey, supervisor of space systems, and Dr. William H. Baier, senior research engineer. ARF specialists in tool engineering, diamond drill design, high altitude research, and geological boring techniques are members of the research team.

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Fluorocarbon Polymers Called "Noble"

Fluorocarbon polymers—comparative newcomers on the chemical scene—were on Sept. 28 termed "noble" among polymeric materials. The fluorocarbons are highly resistant to corrosion and have many other qualities important to industry, the 43rd National Meeting of the American Institute of Chemical Engineers was informed here today.

"As gold, silver, and platinum are considered 'noble' metals because of their general inertness and rarity, so also might the fluorocarbons be considered 'noble' among polymeric materials," Robert P. Bringer and Cedric C. Sjovia, Minnesota Mining and Manufacturing Company, St. Paul, Minn., reported in Tulsa, Okla., in a paper, Fluorocarbon Polymers Meet the Challenge of Corrosion—and Then Some.

"The presence of fluorine renders the fluorocarbons inert to almost every chemical. This inertness, coupled with heat resistance and a variety of other useful properties, makes the fluorocarbons rare indeed among polymers. Ten years ago the types of fluorocarbons available were not only rare but almost as costly as the 'noble' metals. Today, largely because those interested in besting corrosion have recognized the long term economies of quality protection, usage has increased and prices have tumbled. In addition, the polymeric types and forms have increased to the point where the fluorocarbon polymers can be applied in almost any corrosive situation demanding any unique combination of properties."

Such polymers, they pointed out, can be in many forms, paints, lacquers, baked-type coatings, rubbers and plastic linings or used directly as mechanical parts and piping.

"Today's chemical processes, missiles and rockets are ever more demanding in their use of extremely high and low temperatures, and unusually corrosive chemicals. Most polymeric materials are sensitive to wide temperature variation and/or chemicals. The fluorocarbons are answering the need for extremely chemically resistant polymeric materials."

The fluorocarbons have a wide temperature range from —425° F. to 975° F. They have "outstanding electrical insulation properties, extremely low coefficients of friction, zero moisture adsorption, unusual optical properties and unlimited fabrication possibilities. The result is a family of polymers which comes closer to the 'ideal' than any other polymer available today."

They pointed out that as usage increases, "prices can be expected to decrease. And with more companies carrying on fluorocarbon research than ever before, the advent of still better polymers onto the corrosion scene is inevitable."

Had You Heard?

A replica of the ancient visored and crested Roman helmet has found its place in the Navy's jet carrier age, reports *Electronics*. The helmets contain radios that enable deck personnel to communicate over the roar of jets. The visor contains a microphone and the antenna is in the crest.

•

To see if a jet engine would suck up small objects from the ground, test engineers for an aircraft company spread 21 boxes of cereal in front of an engine test stand, *American Machinist/Metalworking Manufacturing* reveals. The engine gulped one normal serving of cereal from the 378 servings available, but no damage was recorded.

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Reviews of Technical Books

Golf

The Geometry of Golf, by William A. Tripp. Published by Vantage Press, Incorporated, New York 1, N. Y. Pages, 57. Price, $2.50.

This easy-to-follow book tells you how to improve your golf game by applying simple engineering principles to the swing. It was written by an engineer in a sincere effort to show the geometrical relationship between how a club is swung to hit the ball correctly and how human hands and wrists can and should be used.

If a player understands simple engineering principles and applies them to his golf swing, he should play a much better game, according to Mr. Tripp. The author does not tell the golfer what not to do and addresses the average player, for whom he outlines basic principles and a definite pattern for practice. Numerous theories are illustrated.

W.L.R.

Structural Analysis

Advanced Structural Analysis, by Sidney F. Borg and Joseph J. Genaro, published by D. Van Nostrand Company Inc., New York, N. Y. 1959. Pages, 360.

This book was written because of the author's firm conviction that present day structural engineers meet in their professional work many topics which are not generally treated in the usual text books on structural design. Perhaps the best way to review a book of this nature is to give a brief list of the contents along with a short description of the more important topics. If any of the readers would like to find out more about this book, they are referred to Chicago Public Library, Technology Department. It can also be found in John Crerar Library.

The first two chapters deal with the general theory of deflections and the applications to the so called "classical" methods of analysis. The next two chapters are devoted to slope deflection and moment distribution methods. The topics in the first four chapters lay a foundation for the more advanced methods of analysis, hence the presentation is very thorough and complete. Chapter Five deals with various problems encountered in arch design. The so called deflection theory of arches is also presented in this chapter. This method, which bears close resemblance to the methods of analysis for suspension bridges, takes into consideration the elastic deflection of arch when solving for redundant stresses.

Numerical and approximate methods of beam deflection analysis, the torsional analysis of building frames, and limit design theories are discussed in separate chapters. Some of the procedures presented in the chapter on beam deflections are particularly adaptable to electronic computer programming as they involve solution of simultaneous equations.

A very important chapter is the one on slab and shell structures. Theoretical solutions involving differential equations of high order are presented. Methods for solving these differential equations are also suggested consistent with various boundry conditions. Presented also are several approximate solutions. Special attention is given to the A.S.C.E. design manual, which eventually will become the standard method of designing such structures in the U. S.

The last two chapters are devoted to temperature problems and a brief introduction to electronic computer programming of structural problems.

H.H.

Small Dams

Design of Small Dams—U. S. Department of Interior, Bureau of Reclamation. U. S. Government Printing Office. Washington 25, D.C. Pages, 611. Price, $6.50.

The science of small dam engineering is comprehensively presented in this volume in a clear and readable manner. This book's wide scope carefully covers every phase, from the initial planning to final working drawings. It also includes recommended specifications. There are examples of design details, and also many photographs throughout the book. It discusses in detail dam development, hydrology, and materials. Various types of dams are described extensively. Spillways, outlet works, stream diversion, maintenance, and operation are described. The appendix lists for the engineer charts and data that include all pertinent information on small dams. The numerous contributors reflect a broad background of experience to make this volume an excellent guide and handbook for the student and for the practicing engineer.

S.W.L.

Parking

Parking, by Geoffrey Baker and Bruno Funaro, published by Reinhold Publishing Corp., New York, N. Y. Pages, 202. Price, $9.50.

Parking is a thorough analysis of the parking problem in the United States with proposed solutions. It discusses location of parking areas, size of parking space required, what type of parking facilities are desirable under specific conditions, and who is to pay.

The volume provides detailed data useful in the design of parking facilities —tables with stall dimensions, stall spacing, aisle widths for various parking angles and ramp slopes.

The book contains many illustrations, drawings, and photos. It is helpful to engineers, architects, and others concerned with parking.

Concrete

Joints and Cracks in Concrete, by Peter L. Critchell, published by Contractor's Record Ltd., Lennox House, Norfolk Street, Strand, London, W. C. Pages, 232. Price, 2.40s.

This book is a guide to the use of joints in concrete structures. It presents many principles and techniques which are helpful in preventing formation of dangerous and/or unsightly cracks.

Various types of joints are described with pointers on when to use them.

Joints and Cracks in Concrete also covers reasons for joints, temperature effects, spacing, materials, design, location, defects, inspection, maintenance, and testing methods.

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Did You Know?

An argument about the horse's gallop led to the first high-speed photographs, reports *Product Engineering*. In 1872, to win a bet that all four hooves left the ground for an instant during a horse's stride, Eadweard Muybridge lined up 24 wet-plate cameras with a separate trip wire to each shutter. A horse galloping past hit the wires, tripped the shutters and produced a series of bet-winning pictures.

•

Workmen in Atlantic City recently used four million steel nails in replacing one-fourth of the city's famous six-mile boardwalk, says *American Machinist/Metalworking Manufacturing*.

•

Skindivers carrying TV cameras are being used to inspect underwater sections of the Tennessee Valley Authority's dams, *Engineering News-Record* reports.

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The government finds that 40 out of every 1000 proposals submitted by inventors as solutions to its publicized research problems have some merit, ten of the 40 ideas are worth testing, and about 2½ of the ten are finally adopted, reports *Product Engineering*.

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News of Engineers

or: Personals of Personable People

G. W. Serat, a member of the Western Society of Engineers, retired on June 1, 1960 after 28 years of service with American Bridge Division, United States Steel Corporation.

Mr. Serat began his engineering career with U. S. Army Engineer Corps during the World War I. Later he worked with Kansas City Structural Steel Co. in Kansas City, specializing in construction of copper smelters and sugar refineries. In 1921 Mr. Serat made Chicago his permanent home. He joined the Robin's Conveying Belt Co. in Chicago where he gained the experience in designing material handling equipment. In 1925 he went to work for Strauss Engineering Corporation where he gained broad experience in designing bridges. One of the most outstanding bridges which he helped to design was the Golden Gate Bridge in San Francisco. With this exceptional training in structural technology Mr. Serat joined the American Bridge Division in 1932, where he assumed the responsibility for the design of many ore bridges for the Corporation, many bascule bridges and such bridges as Pitt River Bridge, Kettle Falls Bridge and many others. He was also responsible for erection procedures for many of the largest bridges in the country.

Mr. Serat has been a member of the Western Society of Engineers since 1932. He was active in the affairs of the Society serving as a member or a chairman of many committees. To the members of the American Bridge Organization he was not only an outstanding engineer but a poet. He had written many fine poems.

At present, Mr. Serat resides in Chicago and attends the University of Chicago.

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Harold B. Gotaas, dean of Northwestern University's Technological Institute, has been named to the engineering sciences committee of the National Science Foundation, Director Alan T. Waterman has announced.

During the three-year appointment Gotaas will advise this federal science-supporting agency on research in the engineering sciences. The NSF last year made 1,809 grants worth $49 million for basic research in the medical, biological and physical (including engineering) sciences.

Dr. Gotaas is recognized widely for his research in the field of sanitary engineering and environmental control. In 1958 he received two awards from the American Society of Civil Engineers—an unprecedented event—for the paper "Photosynthesis in Sewage Treatment," written with Dr. William J. Oswald and published in the *ASCE Transactions*. He received other awards for research while professor and chairman of civil engineering at the University of California, prior to his coming to Northwestern in 1956.

Gotaas' four-year term on the national health advisory council of the U. S. Public Health Service recently expired.

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A national Sales Services Division has been created by S&C Electric Company to coordinate customer service, according to Western Society member **John R. Conrad,** S&C president.

Jack B. Castle, also a Western

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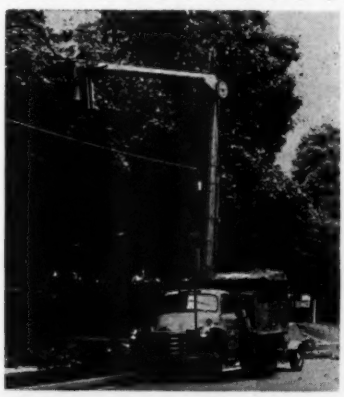

Society member, formerly manager of the East Central Sales Division, will head the new Sales Services Division. Society member **Philip J. McLaughlin** has been promoted from assistant manager to manager of the East Central Sales Division. This Division includes Illinois, Wisconsin, Michigan, Ohio, Indiana, Kentucky, Florida, Georgia, Tennessee, Alabama, North and South Dakota, and Minnesota.

S&C Electric is a leading manufacturer of high-voltage switchgear for electric utilities, industrial plants, and commercial buildings.

Mr. Castle joined S&C in 1953. He graduated from University of Nebraska in 1949 with a Bachelors degree in electrical engineering. He belongs to the American Institute of Electrical Engineers in addition to the Western Society of Engineers. Mr. Castle lives at 653 Euclid Avenue, Highland Park, Ill.

Mr. McLaughlin joined S&C in 1959. He graduated from Rensselaer Polytechnic Institute in 1949 with a Bachelors degree in electrical engineering. He belongs to the American Institute of Electrical Engineers and Western Society of Engineers. Mr. McLaughlin lives at 441 Riverside Drive, Villa Park, Ill.

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William T. Brazelton, associate professor of chemical engineering, has been named assistant dean for undergraduate administration at the Technological Institute of Northwestern University. He was appointed by Harold B. Gotaas, Institute dean.

In his new post, Brazelton will handle curriculum matters and serve as advisor to upperclassmen. With research and the graduate program expanding at Northwestern, he also will be responsible for seeing that the undergraduate interests continue to receive equal attention.

Dr. Brazelton, 39, is a veteran of the 20-year-old Technological Institute, having been on the Northwestern campus since his junior year in college. He was a member of the first graduating class of the Institute (1943), and also received the master's and doctorate there, all in chemical engineering. He became a faculty member in 1947 and was named associate professor in 1954.

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The Board of Directors of Pioneer Service & Engineering Co. announces the election of W. C. Drummond as president of the Company, to succeed Fred C. Kellogg, deceased.

Mr. Drummond, a mechanical engineering graduate of Montana State College, has been with Pioneer and its predecessor, Byllesby Engineering and Management Corporation, since 1925, starting as a mechanical engineer. He became Chief Engineer in 1945 and was elected Vice President in Charge of Engineering in 1953.

From 1920 to 1925 Mr. Drummond was associated with Northern States Power Company.

He is a member of the American Society of Mechanical Engineers, the National Association of Professional Engineers, and was formerly a member of the Prime Movers Committee of the Edison Electric Institute.

•

George Philips has been promoted to assistant director of techno-economics research at Armour Research Foundation. Announcement of his promotion was made by John K. Diederichs, techno-economics research director.

Philips has been a research supervisor since February of this year. He joined ARF in 1955 as an analyst. Educated at the Cooper Union, New York City, Philips received his master's degree from Massachusetts Institute of Technology as an Irving Rossi fellow.

Previous to joining the Foundation, he was with the Ford Motor Company and the New York State Department of Public Works. Philips is now working on his Ph.D. degree at Illinois Institute of Technology and is a part-time instructor in the school's industrial engineering department.

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C. E. Pritchard, general superintendent of rolling mills for Alan Wood Steel Company, has been elected president of the Association of Iron & Steel Engineers. H. L. Jenter, vice president of operations of American Steel & Wire Division, U. S. Steel Corporation, was elected 1st vice president of AISE, and C. W. Bruce, chief engineer of steel plants, Republic Steel Corporation, will serve as 2nd vice president.

Announcement of the new officers for the 8,000 member organization was made as the 1960 AISE Convention and Exposition opened in Cleveland Public Auditorium.

Other officers elected include H. R. Knust treasurer and N. C. Michels, secretary. Mr. Knust is assistant general manager of Bethlehem Steel's Sparrows Point plant, and Mr. Michels is vice president-engineering, Tennessee Coal & Iron Division of U. S. Steel.

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In Memoriam

The Western Society of Engineers has been notified recently of the deaths of the following members:

William G. Sloan ('99, LM), died April 21, 1960.

Frank B. Bills ('28, LM), died May 2, 1960.

Hugues Brussel ('19, LM), died May 16, 1960.

James W. Dansey ('20, LM), died in 1960.

Arthur H. Gerber ('20, LM), died August 14, 1960.

Patrick J. Lucey ('50, M), died August 18, 1960.

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Members of the societies shown above may publish a free advertisement on this page by registering at the nearest E.S.P.S. office. A weekly bulletin of Positions Open is available by subscription at $3.50 a quarter for members and $4.50 a quarter for non-members.

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C-8331 PRODUCTION CONTROL SUPV. IE degree or mgmt. age to 45; Administer, supv. & direct the complete production control dept. of an appliance mfgr. Will be resp. for all planning, scheduling, machine loading, inventory control functions for a mfgr. of stoves, sal. $10/12,000 loc. Chgo., employer will pay the fee.

C-8327 RESEARCH & DEVEL. ENGR. BSME age 30-45; 5+ yrs. exper. as research or design & devel. engr. on mech., pneumatic or hydraulic flow controls or instruments, incl. valves, pneumatic switches & motors, thermostats, servo-mechanisms, meters, recording devices or small mechanisms. Must be imaginative with history of accomplishments incl. patents, publications or articles, or orig. products. High mech. aptitude, knowl. of mfg. problems & methods, sal. $8400/10,000 loc. No. Shore Chgo. Suburb, employer will pay the fee.

C-8316 (B) TECH. SALES ENGR. Grad. CE-Struct. option, age to 33; 3+ yrs. exper. in struct. design work in tech. sales of pre-stressed concrete products. Must have good sales personality & be U. S. citizen for a mfgr. of bldg. products, sal. up to $8400 loc. Chgo. employer will negotiate the fee.

C-8316 (A) ASST. CHIEF ELECT. ENGR. Grad. EE age to 45; Asst. to chief elect. engr. handling installation of elect. eqpt., new design & const., guiding efforts of draftsmen & designers, opportunity to become chief elect. engr. for a mfgr. or bldg. products, sal. to $9600 loc. Chgo., employer will negotiate the fee.

C-8315 (B) EXECUTIVE ENGR. Mech. to report to V. P. Engrg. resp. for establishing, coordinating & supv. admin. standards on world-wide basis, to coordinate tech. operations of company. For a mfgr. of Diesel engines & tractors, sal. $15/20,000 loc. Mich., employer will pay the fee.

C-8302 PLANT ENGR. Grad. Engr. EE, ME Chem. or Civil age to 40; 6+ yrs. exper. in gen'l. engrg. work in mfg. plant on installation, operation & maint. of eqpt. & bldgs. incl. pumps, compressors, conveyors, dryers, crushers, piping, refrig. eqpt., grinding mills & presses. Must have had 2 yrs. exper. in supv. or staff work. Duties: Will prepare sketches & layout drawings for installation of new or replacement of existing eqpt., bldgs. & facilities. Size & select pumps, piping, compressors & condensors, design auto. control system, prepare engrg. reports, analysis & eqpt. specs. Develop & prescribe economical methods & mat'ls. for maint. of eqpt. & bldgs. for a mfgr. of food products, sal. open, loc. Chgo., employer will negotiate the fee.

C-8282 (A)—SR. REGIONAL ENGR. Grad CE or Struct. To be resp. for Chgo.

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CIVIL ENGR. BSCE:PURDUE 35; 1 yr. consulting (subdiv.san.) 8 yrs. heavy indust. construction (steel plant); 2 yrs. drafting & design (small bldgs., railroads, foundations) $9500, Chgo. area. (MW-2007)

SALES & APPLICATION ENGR. BSME Univ. of Ill. 39; Sales & consulting engr. for firm fabricating special weldments, mech. expansion joints & surge suppressors. Can deal very effectively with shop personnel. Have broad diversified knowl. of tech. items gained thru 10 yrs. exper. as asst. plant engr. $10/11,500, Pref. Chgo. Hdqr. (MW-2008)

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MGR. OF RESEARCH & DEVEL. BSME 46; 16 yrs. supv. exper. in res. & devel. on high speed mechanisms, products & eqpt., & involving surveys, feasibility studies, kinematic analyses, design, mfgr. & devel. of prototype models & investigation of spec. problems, available immediately. sal open. (MW-269)

office operations incl. No. Ill. & Ind. doing promotional field work in uses of struct. steel. Should be able to discuss design problems encountered in struct. steel. Must be interested in promotional work & present subject well, sal. open. (B) REGIONAL ENGRS. req'mts. as above, territories: Columbus. Ohio-incl. So. Ind. & No. Ky.; Omaha Hdqr.-incl. W. Iowa, Nebr. & Wyo., Colo. & W. Kans.; Minneapolis Hdqr.-incl. Minn., No. & So. Dak., E. Mont. & W. Wisc. Should be registered struct. engr. or able to obtain license, sal. open for a trade assoc., employer will negotiate the fee.

WSE Applications

In accordance with Article 1, Section 5 of the By-Laws of the Western Society of Engineers, there is published below a list of applicants for admission received since the last issue of the MIDWEST ENGINEER *magazine.*

William V. Sayner, Jr., 20 Perkins Hall, Cambridge 38, Mass., attending Harvard Graduate School of Design.

L. F. Engle, Project Manager, Western-Knapp Engineering Co., 205 W. Monroe St.

E. J. Jedlicka, Dept. Chief-Equipment Eng., Western Electric Co., Inc., Merchandise Mart Plaza.

George F. Jones, Sales Engineer, Wheelabrator Corp., Mishawaka, Ind.

Robert K. Metcalf, Staff Engineer, Illinois Bell Telephone Co., 208 W. Washington St.

Chester M. Wiig, Vice Pres. Eng.-Chief Eng., F. J. Littell Machine Co., 4101 N. Ravenswood Av.

Paul G. Nicks, Department Chief, Western Electric Co., Inc., Merchandise Mart Plaza.

Donald P. Schmeisser; Assist. Supt., Equip. Engrg., Western Electric Co., Inc., Merchandise Mart Plaza.

Responsibilities of Engineers Defined

The professional responsibilities of an engineer were sharply defined at a convention session of the American Society of Civil Engineers on Oct. 11 in Boston, Mass.

Frank A. Butrico, chief of the Engineering Resources Program of the U.S. Public Health Service, told the gathering that the completion of certain academic requirements does not of itself entitle the engineer to "lasting professional recognition."

"Just as the doctor and the lawyer must meet certain standards and comply with licensing procedures, so should the engineer before being allowed to practice engineering," Butrico stated.

"Registration is being recognized increasingly by professional and technical organizations and employers."

He referred to the requirement of the American Society of Civil Engineers that no member can now reach ASCE's highest grade, of Fellow, unless he has become a registered engineer of the state in which he operates.

Butrico offered four criteria, or characteristics, of the professional man—willingness to work to advance the profession, registration, communication, and leadership in public life.

Regarding communication, he said that "most of us fall completely flat" when it comes to writing technical articles, and that there is too much of a tendency to "let George do it!"

But he added that a more important short-coming was the lack of the engineer's ability to write for the lay public. He said it is unfortunate that the engineer's jargon at technical meetings is often carried outside and used to address laymen.

"Maybe we do it to impress people, but we certainly do not influence them."

"If the public does not understand the message, it is not going to support us as a profession and to support our engineering projects."

He also called for more engineer-statesmen who can help influence public policy.

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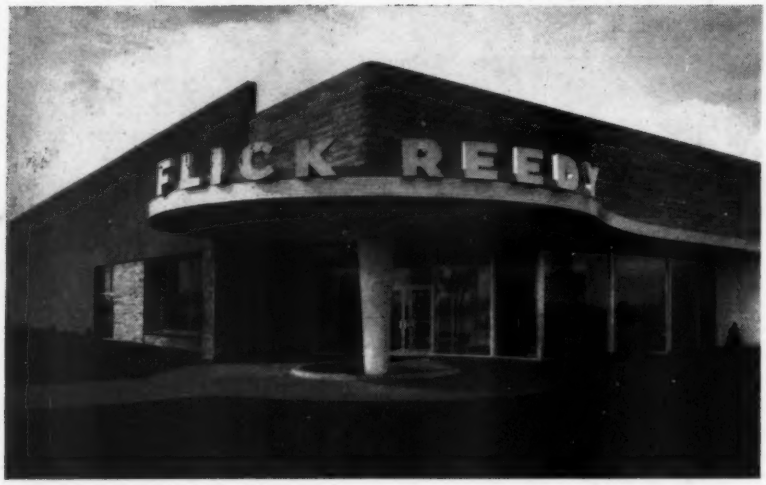

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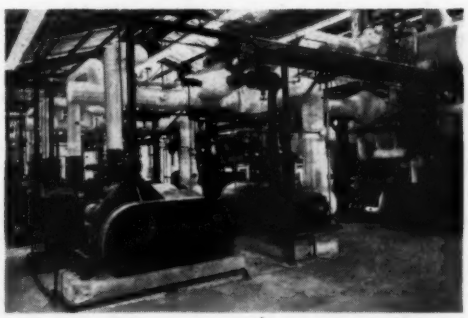
Important everyday benefits of this new heat pump system include greater cleanliness; more comfort; increased efficiency and morale of workers; less turnover; more production; cut in absenteeism (due to colds). Flick Reedy's Miller Fluid Power Division, manufacturers of precision air and hydraulic cylinders, also required controlled temperatures that eliminate the expansion and contraction of precision parts ordinarily encountered with temperature variations.



Entire heating-cooling plant is located here. Electric heat pumps require no separate boiler room or fuel storage facilities.

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